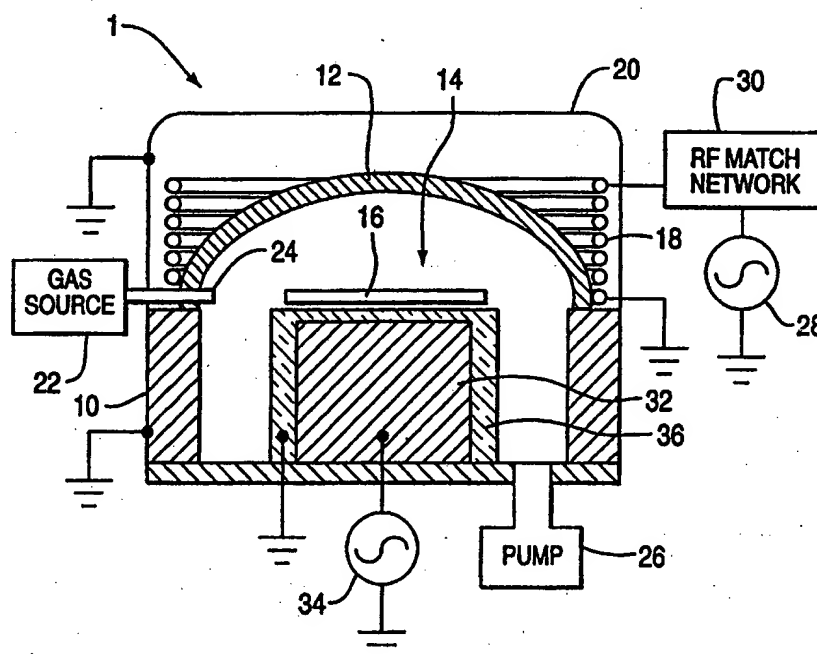




INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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(54) Title: NEW ETCH PROCESS FOR FORMING HIGH ASPECT RATIO TRENCHES IN SILICON



(57) Abstract

A multistep etch process for forming high aspect ratio trenches in silicon having a silicon oxide and/or silicon nitride hardmask. In a first step, an etch composition of HBr and oxygen is used, depositing a passivation layer on the sidewalls and producing slightly tapered openings. In the second step, an etch composition of a fluorine-containing gas such as SF₆, HBr and oxygen is used, producing more vertical openings at a high etch rate. The taper of the openings during the second step can be controlled by adjusting the relative amount of HBr or SF₆ employed. This process is a clean process that does not require cleaning of the etch chamber between etch steps.

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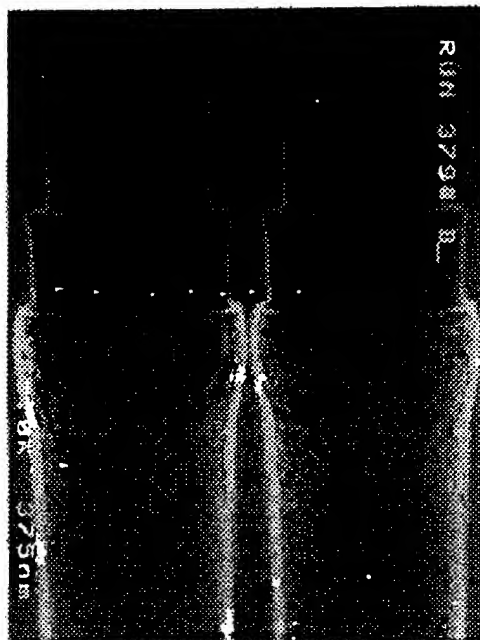


FIG. 1

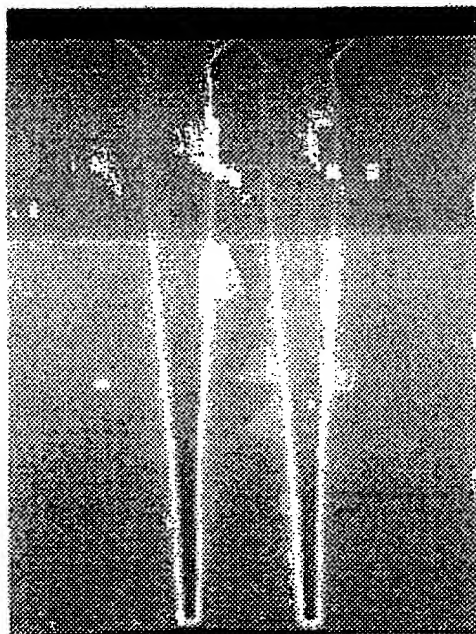
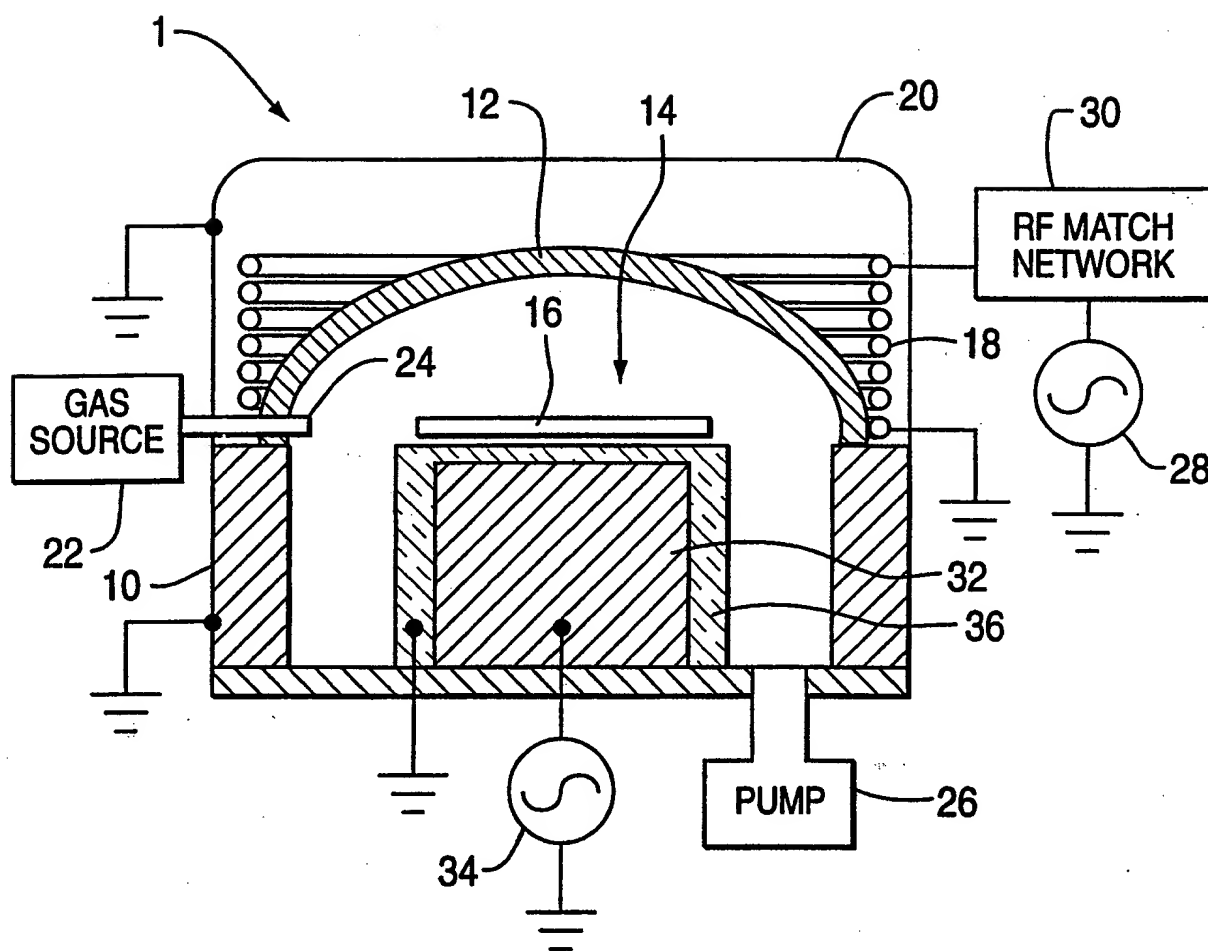


FIG. 8

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**FIG. 2**

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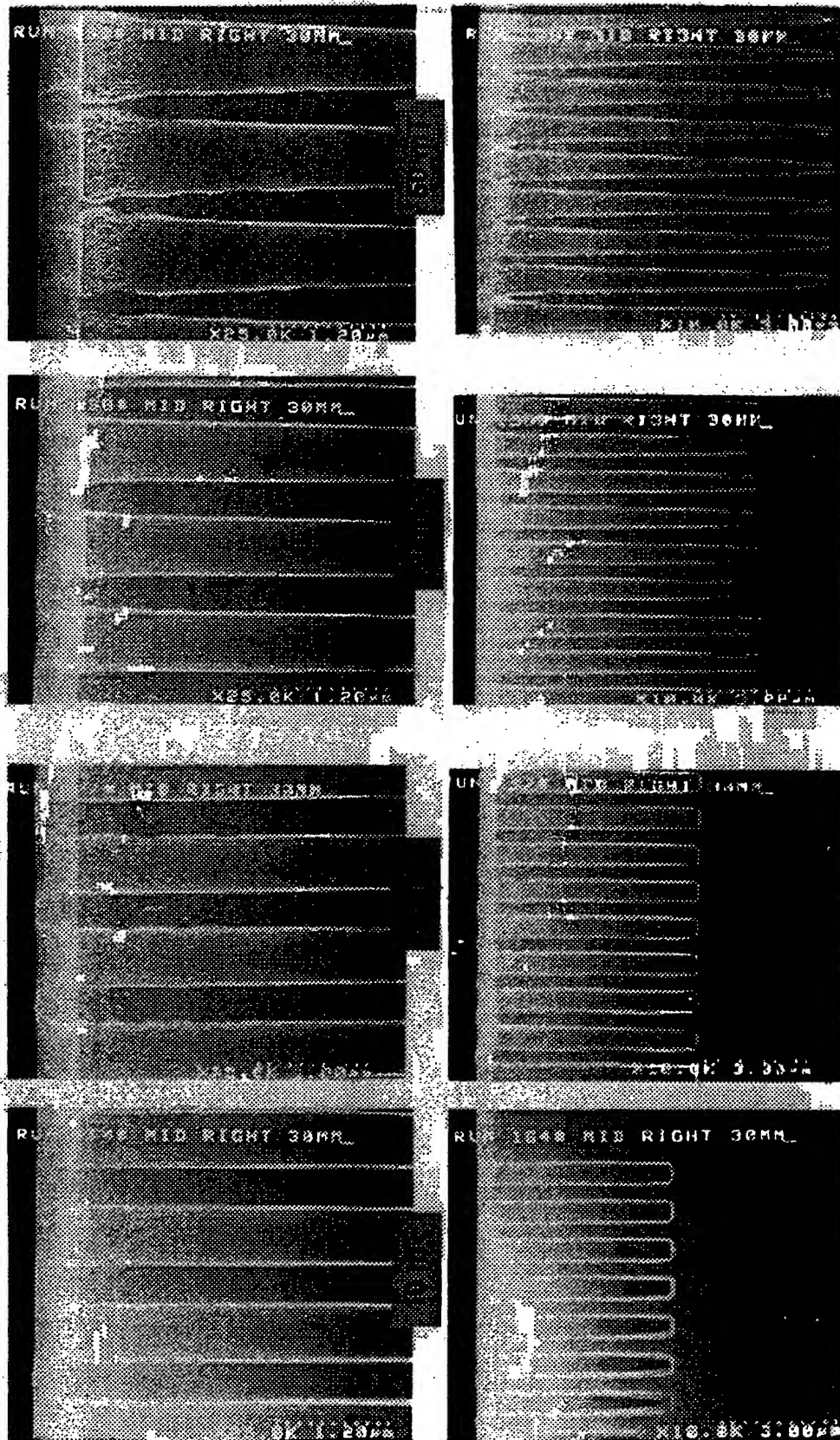


FIG. 3

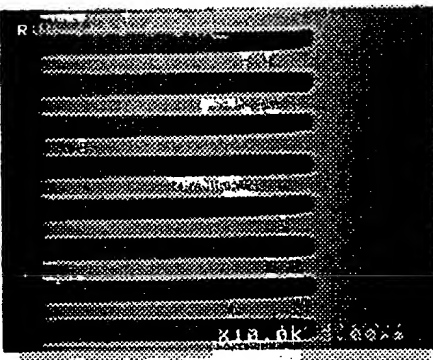
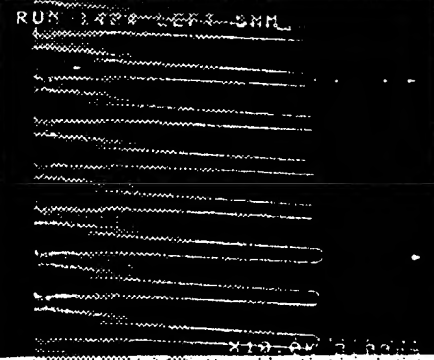
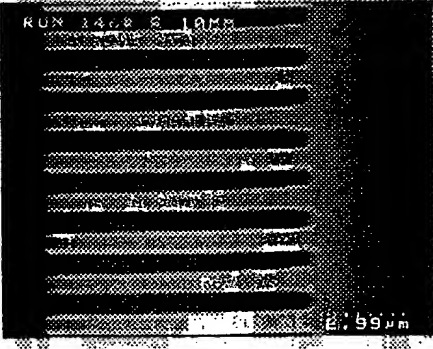
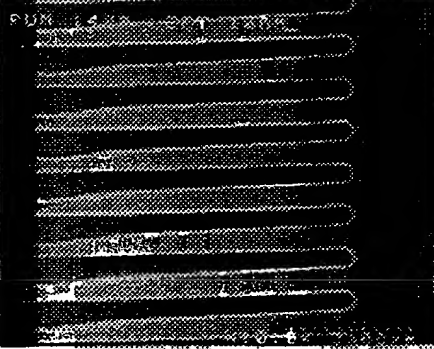
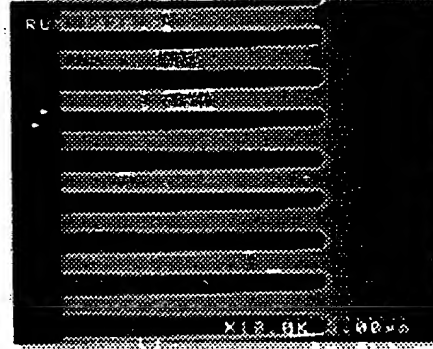
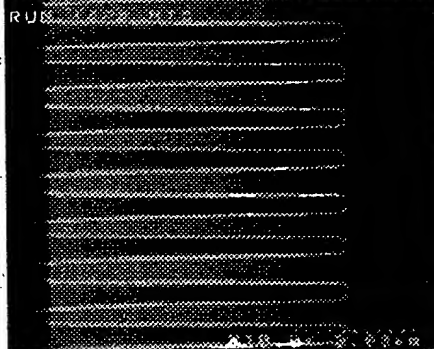
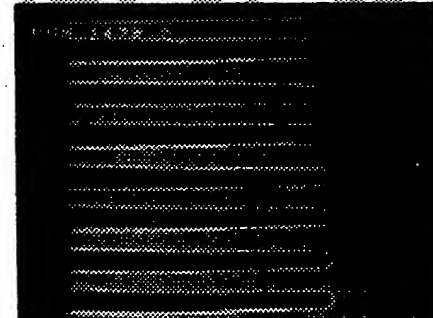
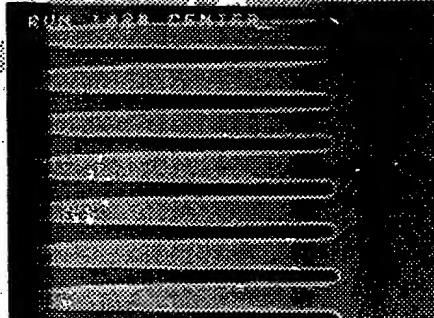
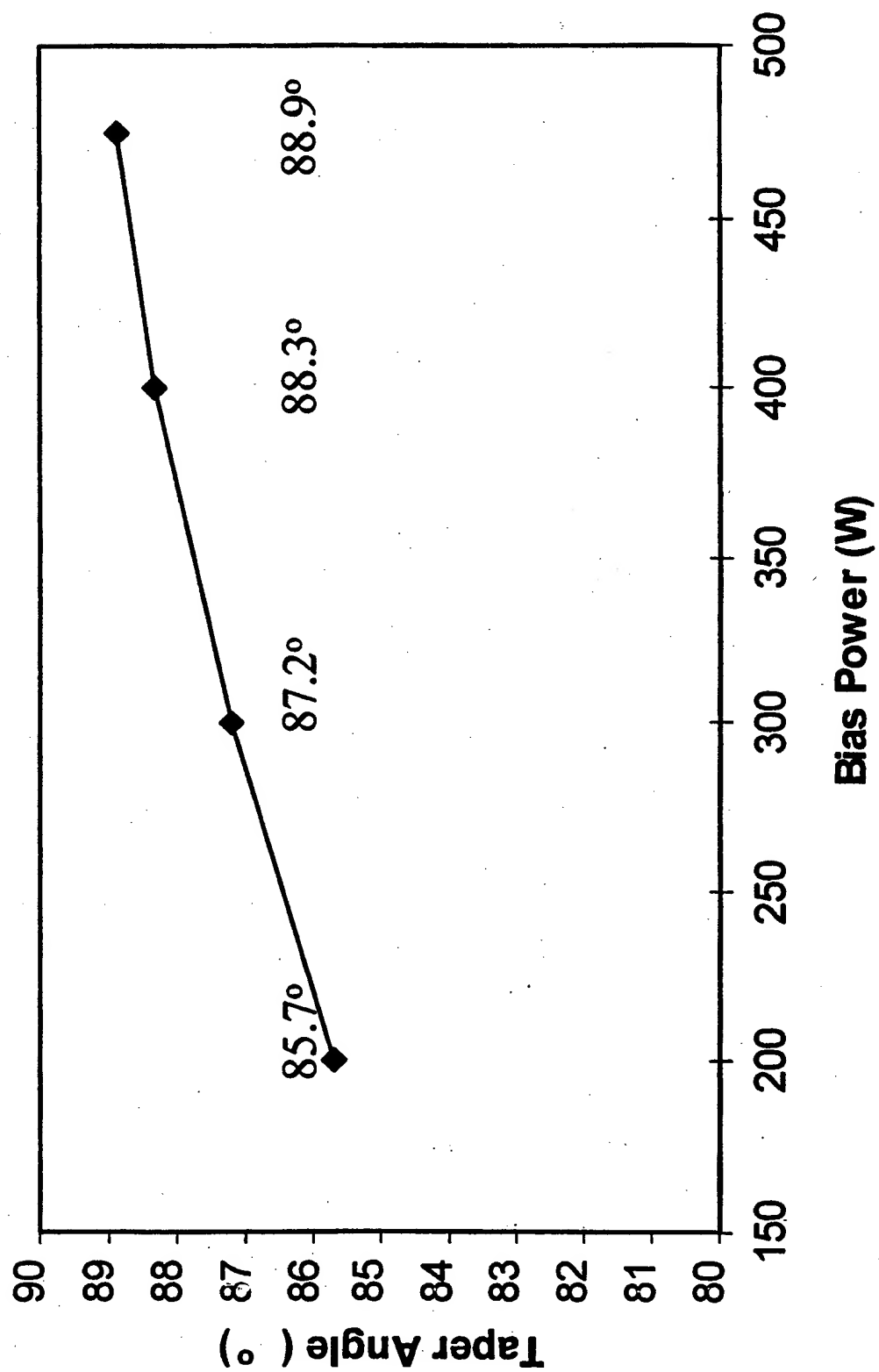
| Bias Frequency | 400KHz | 13.56MHz |
|-------------------|---|--|
| Edge 5 mm |  |  |
| Edge 10 mm |  |  |
| Middle |  |  |
| Center |  |  |

FIG. 4

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**FIG. 5**

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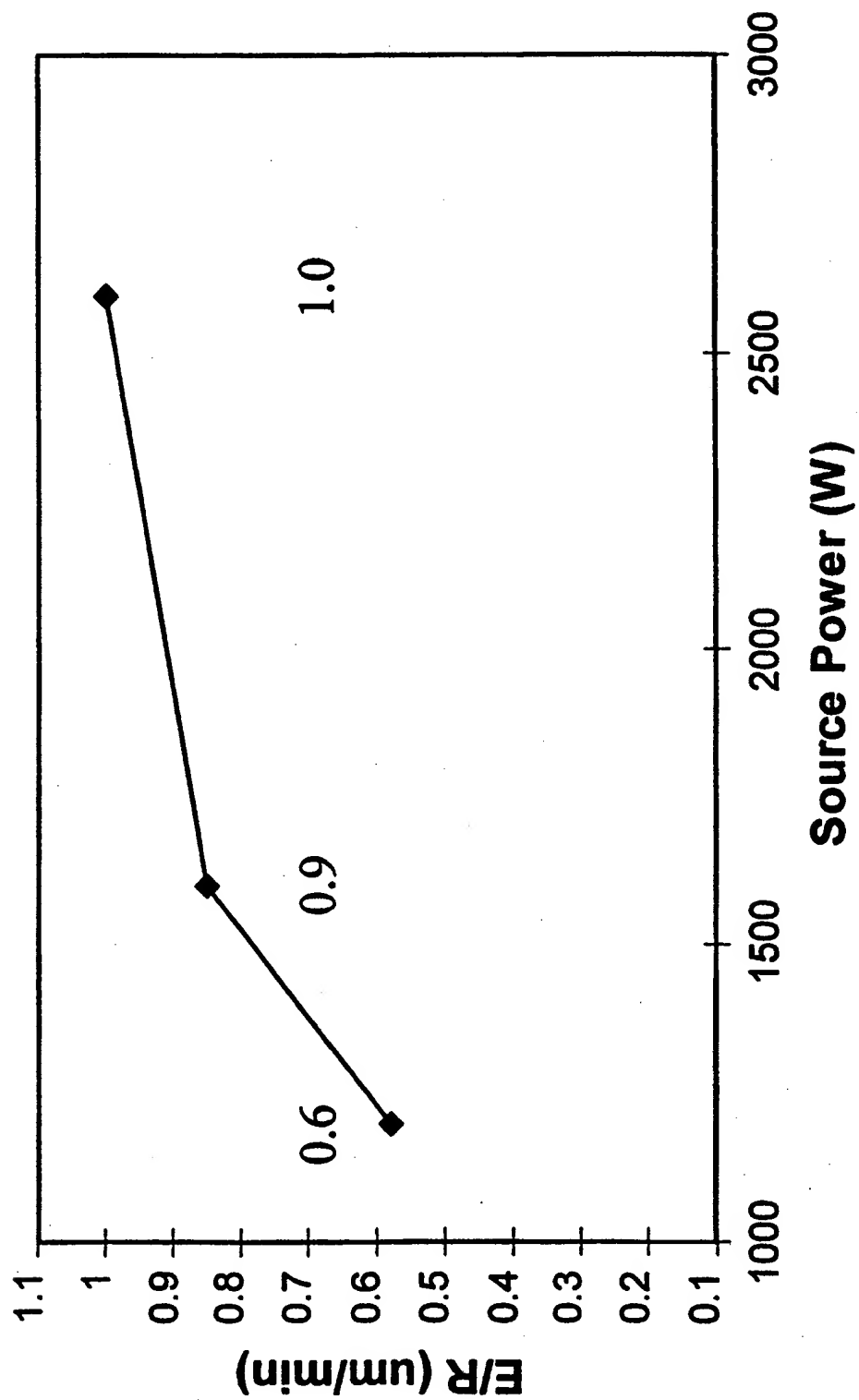


FIG. 6

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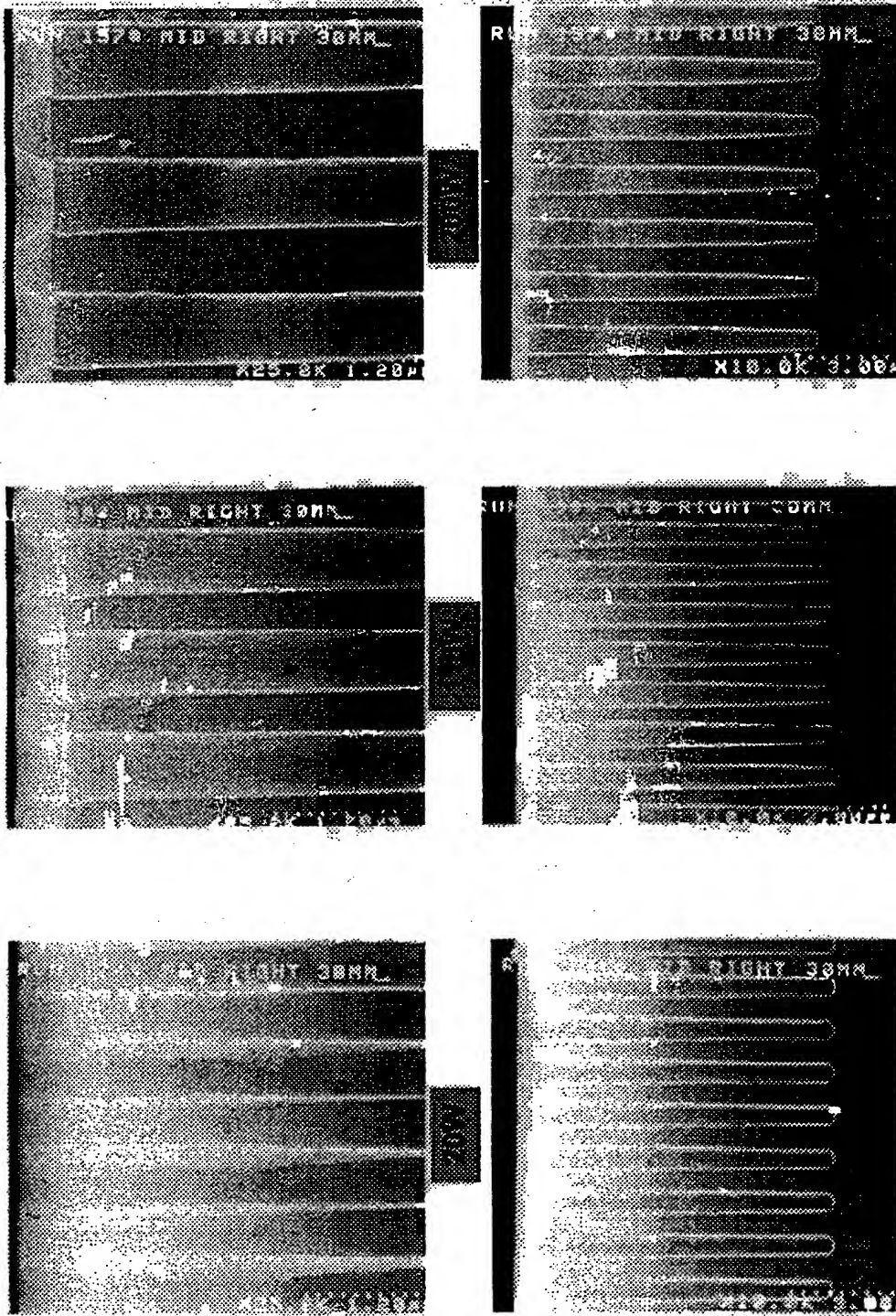


FIG. 7

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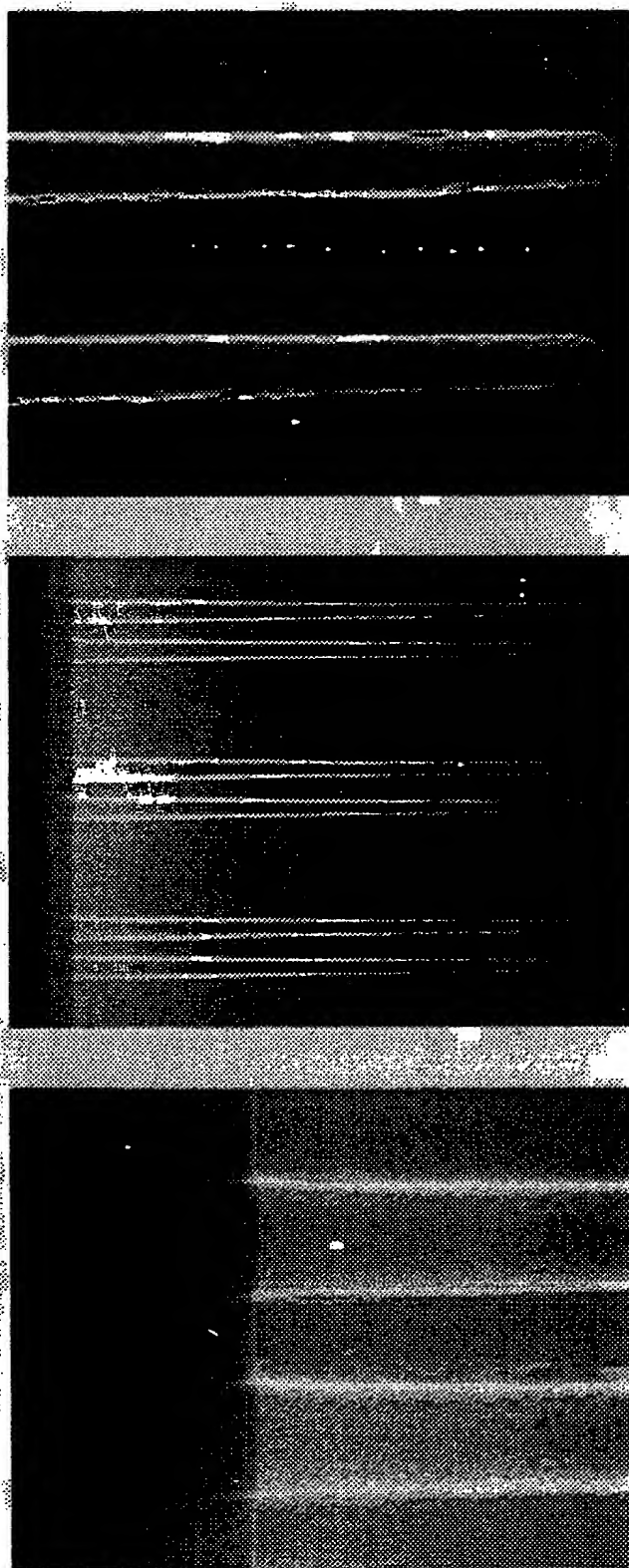


FIG. 9

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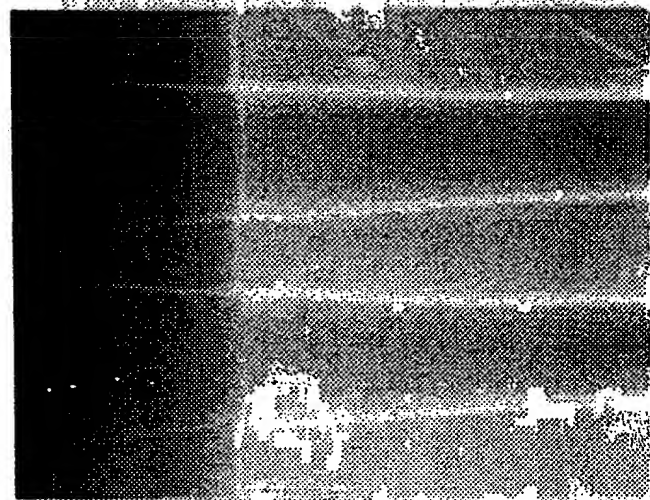
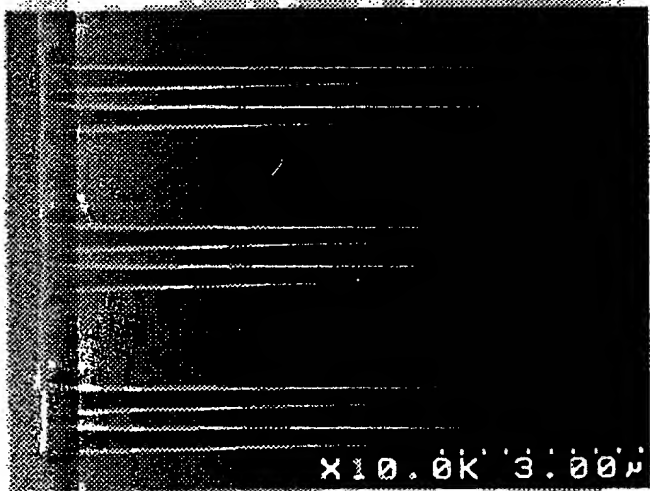
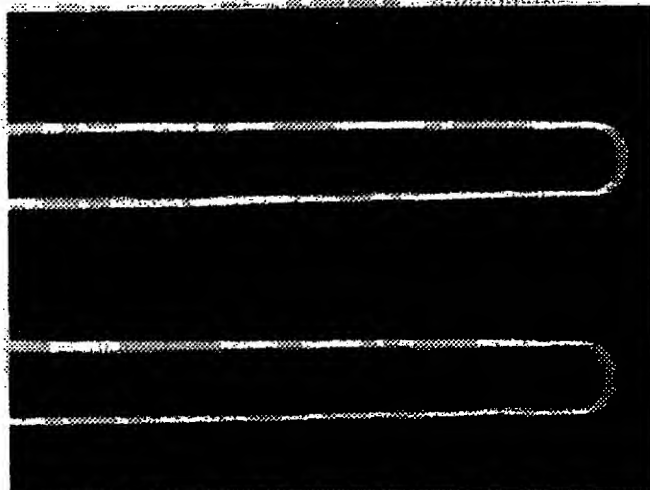


FIG. 10

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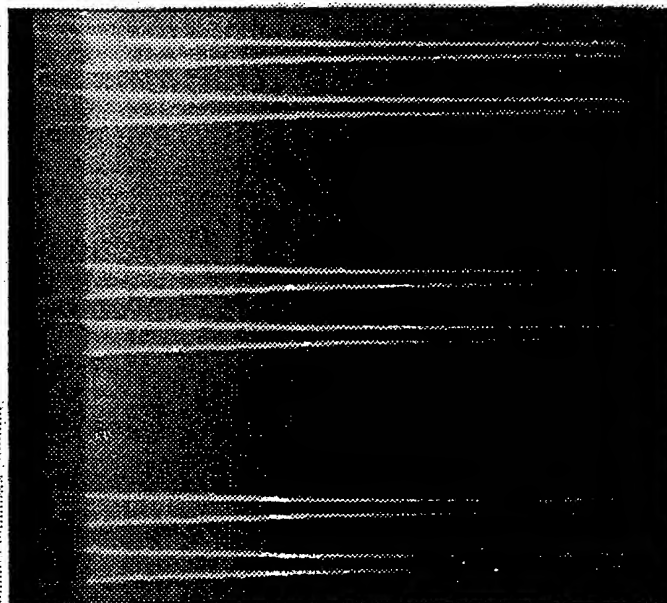


FIG. 13

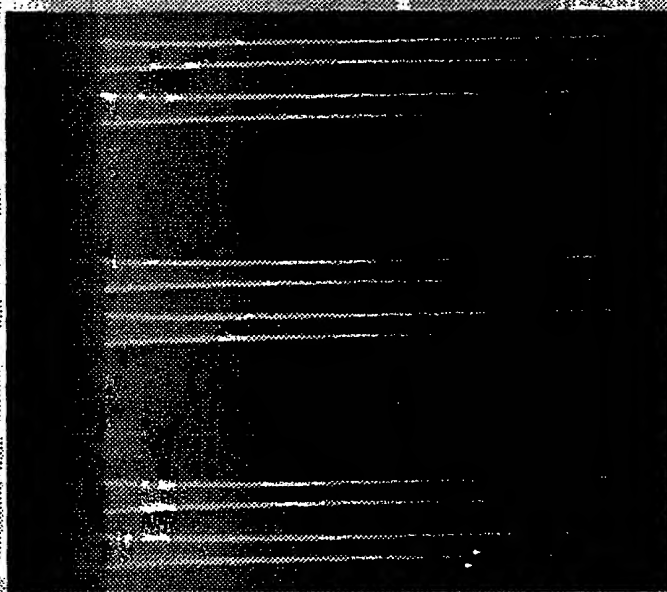


FIG. 12

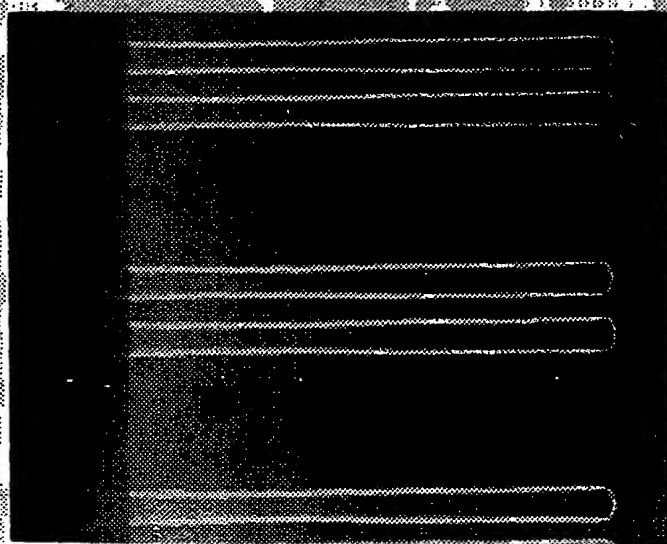


FIG. 11

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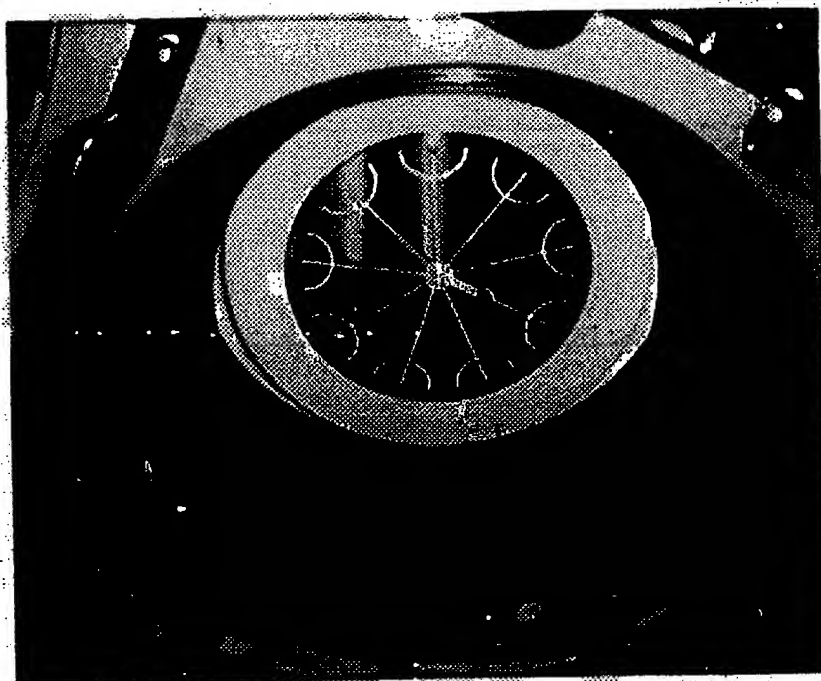


FIG. 14

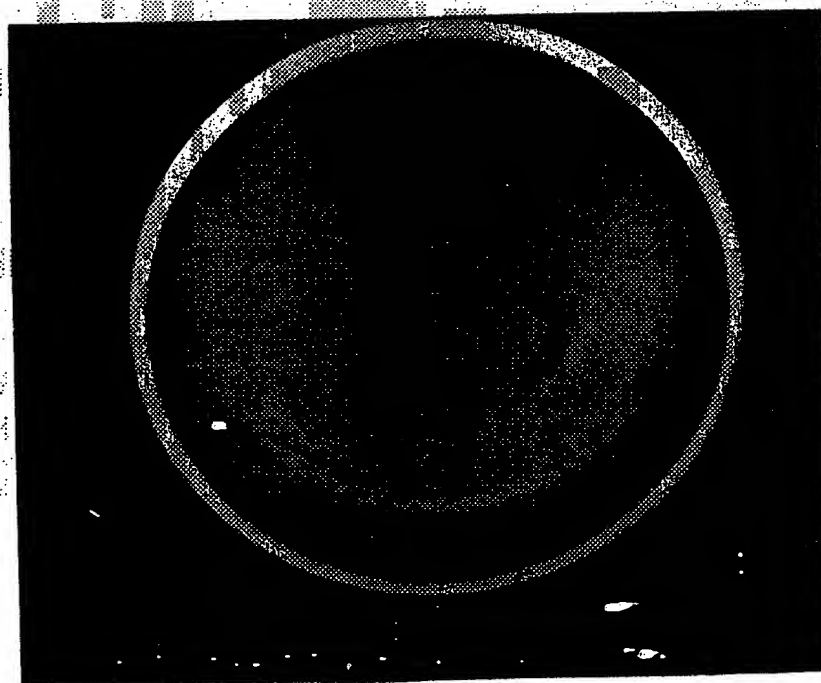


FIG. 15